

WHAT IS CLAIMED IS:

1                   1.       A method for measuring optical tissues of an eye, the method  
2 comprising:  
3                   transmitting an image through the optical tissues;  
4                   determining local gradients across the optical tissues from the transmitted  
5 image; and  
6                   mapping an error-correcting change in the optical tissues by integrating across  
7 the gradients.

1                   2.       The method of claim 1, wherein the image is transmitted from the  
2 retina anteriorly through the optical tissues.

1                   3.       The method of claim 2, further comprising transmitting a source image  
2 from a light source posteriorly through the optical tissues and onto the retina to define the  
3 image.

1                   4.       The method of claim 3, wherein the image comprises a small spot or  
2 point.

1                   5.       The method of claim 3, wherein the image is transmitted posteriorly  
2 through a central region of the cornea, the central region having a size which is significantly  
3 less than a pupil size of the eye.

1                   6.       The method of claim 5, wherein the central region has a width of  
2 between about 1 and 4 mm.

1                   7.       The method of claim 2, wherein the mapping step comprises deriving a  
2 proposed change in the optical tissue surface elevations so as to effect a desired change in  
3 optical properties of the eye, and further comprising modifying the optical tissue surface  
4 according to the proposed change by laser ablation.

1                   8.       The method of claim 1, wherein the image is transmitted by the optical  
2 tissues as a plurality of beamlets, wherein the gradients comprise an array of gradients, each  
3 gradient corresponding to an associated portion of an optical surface, each beamlet being  
4 transmitted through the optical tissue according to the corresponding gradient.

1 9. The method of claim 8, wherein the integrating step comprises  
2 integrating along a closed integration path across the gradient array.

1 10. The method of claim 9, further comprising determining an accuracy of  
2 the gradient array by calculating a change in elevation along the closed integration path.

1 11. The method of claim 9, wherein the closed integration path extends  
2 from a first center of a first portion of the optical surface to a second center of a second  
3 portion of the optical surface, from the second center to a third center of a third portion of the  
4 optical surface, and from the third center back to the first center, the first, second and third  
5 portions of the optical surface corresponding to the first, second and third gradients of the  
6 gradient array, respectively.

1 12. The method of claim 9, wherein the closed integration path extends  
2 from an initial location corresponding to a position between a first gradient array element and  
3 a second gradient array element, the path crossing a first portion of the optical surface  
4 corresponding to the second gradient array element, a second portion of the optical surface  
5 corresponding to a third gradient array element, and a third portion of the optical surface  
6 corresponding to a fourth gradient array element before returning back to the initial location.

1 13. The method of claim 1, further comprising adjusting the image with an  
2 adaptive optical element so as to compensate for errors of the optical system.

1 14. The method of claim 1, wherein an elevation map of an optical surface  
2 of the optical system is generated directly in the mapping step without deriving coefficients  
3 of a series expansion mathematically approximating the optical surface.

1 15. A method for measuring optical tissues of an eye, the method  
2 comprising:  
3 transmitting an image through the optical tissue;  
4 determining local gradients across the optical tissue from the transmitted  
5 image; and  
6 mapping a wavefront error of the eye by integrating the gradients across the  
7 tissue.

1 16. The method of claim 15, wherein the step of integrating further

2 comprises:

3 integrating along a closed integration path across a gradient array.

1 17. The method of claim 16, further comprising determining an accuracy  
2 of the gradient array by calculating a change in elevation along the closed integration path.

1 18. A method of determining an accuracy of a gradient array in an optical  
2 tissue measurement comprising:

3 transmitting an image through the optical tissue;

4 determining local gradients across the optical tissue from the transmitted  
image; and

integrating along a closed integration path across a portion of the array.

19. The method of claim 18, further comprising:

calculating a change in elevation along the closed integration path across the  
portion of the array.

20. The method of claim 18 wherein, the closed integration path  
comprises:

a common starting point, a common ending point, a first integration path  
connecting the common starting point to the common ending point, and a second integration  
path connecting the common starting point to the common ending point, the first and second  
integration paths being different.

21. A system for diagnosing an eye of a patient, the eye having a retina  
and optical tissues, the system comprising:

an image source arranged to direct an image posteriorly through the optical  
tissues and onto the retina;

a wavefront sensor oriented to sense the image as transmitted anteriorly by the  
optical tissue, the wavefront sensor generating signals indicating gradients across the optical  
tissues; and

a processor having an integration module configured for integrating among the  
gradients to determine a map for correction of the optical tissues.

1                   22.     The system of claim 21, wherein the processor directly determines a  
2 surface elevation map of an optical surface without generating coefficients of a series  
3 expansion mathematically approximating the surface.

1                   23.     The system of claim 21, wherein the processor comprises a computer  
2 executable code performing the method of claim 15 or 18.

1                   24.     A method of measuring a tomographic wavefront error map of an eye,  
2 the method comprising:  
3                   deflecting a light measurement path of a wavefront sensor to a first angular  
4 orientation relative to the eye;  
                    measuring the eye at the first angular orientation;  
                    deflecting the light measurement path to a second angular orientation;  
                    measuring the eye at the second angular orientation; and  
                    calculating the tomographic wavefront error map of the eye from the  
5 sequential measurements, the map comprising a plurality of localized optical tissue surfaces  
6 of the eye at different depths of the eye.

1                   25.     The method of claim 24 wherein a first optical tissue surface is  
2 measured at the first angular orientation and a second optical tissue surface is measured at the  
3 second angular orientation, and further comprising:  
4                   forming a light structure having a feature on a retina of the eye; and  
5                   repeating the steps of measuring and deflecting to obtain a plurality of  
6 sequential optical tissue surface measurements..

1                   26.     The method of claim 25 further comprising displacing a position of the  
2 light structure from a first position to a second position so that a feature of the light structure  
3 in the second position is resolvable from the feature of the light structure in the first position.

1                   27.     A method of selecting an aberration of an eye for treatment  
2 comprising:  
3                   calculating a tomographic wavefront error map of an eye comprising a  
4 plurality of localized optical tissues surfaces of the eye;  
5                   corresponding the aberration with a tissue structure of the eye;

6 selecting the aberration for treatment in response to the structure  
7 corresponding to the aberration; and  
8 combining a plurality of aberrations selected for treatment to obtain an optical  
9 treatment surface.

1 28. The method of claim 27 further comprising including the aberration  
2 corresponding to a corneal tissue structure of an eye and excluding the aberration  
3 corresponding to a lenticular tissue structure of an eye.

1 29. The method of claim 27, wherein the plurality of aberrations selected  
2 for treatment is a subset of a plurality of aberrations of the eye.

1 30. A method of selectively treating an aberration in an optical tissue  
2 surface of an eye comprising:  
3 corresponding the aberration with a tissue structure of the eye;  
4 selecting the aberration for treatment in response to the structure  
5 corresponding to the aberration;  
6 combining a plurality of aberrations selected for treatment to obtain an optical  
7 treatment surface; and  
8 sculpting a cornea of the eye with a pattern of laser beam pulses to correct for  
9 the selected aberrations of the optical treatment surface.

1 31. The method of claim 30 further comprising including the aberration  
2 corresponding to a corneal tissue structure of an eye and excluding the aberration  
3 corresponding to a lenticular tissue structure of the eye.

1 32. A method of measuring a wavefront map of an eye comprising:  
2 deflecting a light measurement path of a wavefront sensor to a first angular  
3 orientation relative to the eye;  
4 measuring a first optical tissue surface of the eye at the first angular  
5 orientation of the measurement path relative to the eye;  
6 deflecting the light measurement path to a second angular orientation;  
7 measuring a second optical tissue surface at the second angular orientation;  
8 and  
9 calculating the wavefront error map of the eye from the sequential optical  
10 tissue surface measurements.

1                    33.    The method of claim 32 further comprising repeating the steps of  
2    deflecting and measuring to obtain a plurality of optical tissue surface measurements.

1                    34.    The method of claim 33 further comprising:  
2                    forming a light structure having a feature on the retina; and  
3                    displacing a position of the light structure from a first position to a second  
4    position so that a feature of the light structure in the second position is resolvable from the  
5    feature of the light structure in the first position.

1                    35.    A machine-readable code comprising instructions for effecting the  
2    method recited in claims 24, 27, 30, or 32.